

End-of-Mission Passivation: Successes and Challenges

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The passivation of spacecraft and launch vehicle orbital stages at end-of-mission has been a principal space debris mitigation measure world-wide since the 1980's. Space vehicle passivation includes the removal of stored energies, especially those associated with propulsion and electrical power systems. Prior to 2007 the breakup of non-functioning, non-passivated space vehicles was the major source of hazardous debris in Earth orbit. The United Nations and the Inter-Agency Space Debris Coordination Committee have both included passivation in their formal space debris mitigation guidelines. This often simple countermeasure has been adopted by many spacefaring countries and organizations and has undoubtedly prevented numerous major satellite breakups. For some existing space vehicle designs, passivation requires changes in hardware, software, and/or operational procedures. Questions about the permissible degree of passivation for both current and future space vehicles have arisen and are addressed herein. An important element to be considered is the potentially long period in which the space vehicle will remain in orbit, *i.e.*, up to 25 years after mission termination in LEO and for centuries in orbits above LEO. Finally, the issue of passivation of space vehicles which have failed prematurely is addressed.